Letter to the Editor

Antimicrobial resistance among isolates cultured from patients hospitalized with lower respiratory tract infection in Europe

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Lower respiratory tract infections represent a major concern, especially with increasing numbers of resistant *Streptococcus pneumoniae*, extended-spectrum β-lactamase-producing Enterobacteriaceae, and *Staphylococcus aureus* with reduced susceptibility to vancomycin. Here, we report on the susceptibilities of isolates cultured from patients with lower respiratory tract infection to different antibiotics obtained from 20 western and central European hospitals in 1997 and 1998 as part of the SENTRY Antimicrobial surveillance Program.[1]

In total, 2083 isolates were obtained. The most frequently isolated organisms from patients with lower respiratory tract infection were *Staphylococcus aureus* and *Pseudomonas aeruginosa*, comprising 21.0% and 20.3% of the isolates, respectively, followed by *Enterobacter* spp. (7.9%), *Escherichia coli* (7.0%), *Streptococcus pneumoniae* (5.7%), *Haemophilus influenzae* (4.7%), *Acinetobacter* spp. (4.4%), *Klebsiella pneumoniae* (4.3%), *Serratia* spp. (3.8%), and *Stenotrophomonas maltophilia* (2.6%). The large contribution of *Staphylococcus aureus* is in agreement with a 1996 American national nosocomial infection surveillance report, which showed that *Staphylococcus aureus* was the commonest cause of pneumonia, accounting for 19% of all isolates.[2] Comparison of the frequency of isolation of bacterial species cultured from patients with lower respiratory tract infection in hospitalized patients between the European and Latin American arms of SENTRY shows that *P. aeruginosa* and *Staphylococcus aureus* are the top two species, although their order is reversed.[3] *Acinetobacter* spp. ranked third in Latin America, with 11.9%, compared to seventh position in Europe. On the other hand, only 1.4% of the isolates were *Streptococcus pneumoniae* in Latin America, compared to 5.7% in Europe. Notably, *H. influenzae* is absent among the top 10 species isolated in Latin America.

The MIC_{50}s, MIC_{90}s and percentage susceptibilities of *Staphylococcus aureus* and *Streptococcus pneumoniae* for various antibiotics are presented in Tables 1 and 2, respectively. Intermediate-resistant penicillin-resistant isolates were obtained from Germany, France, Spain, and Poland. The highly resistant isolates were obtained from Germany, France, and Spain. All isolates, with the exception of two penicillin-resistant *Streptococcus pneumoniae* isolates from France, were completely susceptible to quinupristin–dalfopristin.

The MIC_{50}s, MIC_{90}s and percentage susceptibilities of Enterobacteriaceae and other Gram-negative bacteria for various antibiotics are presented in Tables 3 and 4, respectively. *H. influenzae* was susceptible to all β-lactam and fluoroquinolone antibiotics tested. Based on resistance against ceftazidime, ceftriaxone, or aztreonam, four (2.7%) *E. coli* isolates and 13 (14.4%) *K. pneumoniae* isolates carried an extended-spectrum β-lactamase or were overproducers of AmpC.

Resistance to various antibiotics also tended to be higher for isolates from southern Europe, and isolates from hospitalized patients with lower respiratory infection showed markedly higher rates of resistance against most antibiotics compared to isolates from community-acquired pneumonia.[4] In comparison to Gram-negative isolates from Latin America, the European isolates generally have clearly higher susceptibilities to almost all antibiotics tested.[3]

With the exception of *Acinetobacter* spp., the susceptibilities of bacterial isolates cultured from patients with lower respiratory tract infection to various antibiotics still allow adequate treatment with traditional

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Table 1. Antimicrobial susceptibility (%S) and spectrum of activity ($MIC_{50/90}$) of different antimicrobial agents against *S. aureus* isolates obtained from patients with lower respiratory tract infection.

	Isolates			
	MRSA (n=151)[a]		*MSSA (n=289)*	
Antimicrobial agents	$MIC_{50/90}$ µg/ml	*%Susc*	$MIC_{50/90}$ µg/ml	*%Susc*
Cefazolin	>16/>16	0.0	≤2/4	100.0
Ceftriaxone	>32/>32	0.0	2/4	100.0
Imipenem	>8/>8	0.0	≤0.06/0.25	100.0
Gentamicin	>16/>16	29.8	0.5/1	95.9
Ciprofloxacin	>2/>2	8.6	0.25/>2	88.2
Erythromycin	>8/>8	6.6	0.5/>8	75.1
Clindamycin	>8/>8	17.9	0.12/0.25	91.4
Quinupristin/dalfopristin	0.5/0.5	98.0	0.25/0.5	99.7
Doxycycline	4/>4	94.8	≤0.5/≤0.5	98.6
Minocycline[b]	2/4	100	≤0.25/0.25	98.4
Rifampin	1/>2	50.3	<0.25/<0.25	98.3
Teicoplanin	1/2	100.0	0.5/1	100.0
Vancomycin	1/2	100.0	1/1	100.0

[a]MRSA=methicillin-resistant *S. aureus*; MSSA=methicillin-sensitive *S. aureus*; [b]number of MRSA isolates tested 55: number of MSSA isolates tested: 127.

Table 2. Antimicrobial susceptibility (%S) and activity spectrum ($MIC_{50/90}$) of different antimicrobial agents against *Streptococcus pneumoniae* obtained from patients with lower respiratory tract infection.

	Isolates					
	PS-S. pneumoniae (n=88)[a]		*PI-S. pneumoniae (n=18)*		*PR-S. pneumoniae (n=15)*	
Antimicrobial agent	$MIC_{50/90}$ µg/ml	*%Susc*	$MIC_{50/90}$ µg/ml	*%Susc*	($MIC_{50/90}$ µg/ml	*%Susc)*
Amoxicillin	≤0.06/≤0.06	100.0	0.5/2	66.7	2/>8	0.0
Penicillin	≤0.03/0.06	100.0	0.5/1	0.0	2/4	0.0
Cefotaxime	0.015/0.03	100.0	0.12/1	88.9	1/2	20.0
Cefuroxime	≤0.06/0.12	100.0	0.5/4	55.6	8/8	0.0
Levofloxacin	1/2	98.9	1/2	100.0	1/2	100.0
Grepafloxacin	≤0.12/0.25	100	≤0.12/0.25	100.0	≤0.12/≤0.12	100.0
Trovafloxacin	0.12/0.5	100	0.12/0.25	100.0	0.25/0.5	100.0
Gatifloxacin[b]	0.25/0.5	—	0.25/0.25	—	0.25/0.5	—
Erythromycin	≤0.25/0.5	88.6	0.5/>32	44.4	>32/>32	0.0
Clindamycin	≤0.06/≤0.06	96.6	0.25/>8	61.1	>8/>8	13.3
Azithromycin	≤0.12/0.25	94.3	0.5/>16	50.0	>16/>16	13.3
Quinupristin/dalfopristin	0.5/0.5	100.0	0.5/1	100.0	0.5/ 2	80.0
Vancomycin	0.25/0.5	100.0	0.25/0.5	100.0	0.5/0.5	100.0

[a]PS=penicillin-susceptible; PI=penicillin-intermediate resistant; PR=penicillin-resistant; [b]investigational drug, no NCCLS breakpoint defined.

Table 3. Antimicrobial susceptibility and spectrum of activity of different antimicrobial agents against the most prevalent Enterobacteriaceae cultured from patients with lower respiratory tract infections.

	Isolates							
	E. coli (147)		*Enterobacter spp. (167)*		*K. pneumoniae (90)*		*Serratia spp. (79)*	
Antimicrobial agent	$MIC_{50/90}$ µg/ml	*%Susc*	$MIC_{50/90}$ µg/ml	*%Susc*	$MIC_{50/90}$ µg/ml	*%Susc*	$MIC_{50/90}$ µg/ml	*%Susc*
Ampicillin	>16/>16	46.3	>16/>16	34.7	>16/>16	6.7	>16/ >16	17.7
Piperacillin	4/>128	53.7	2/>128	65.3	16/>128	61.1	≤1/>128	81.0
Amoxicillin/clavulanate	1/16	76.2	>16/ >16	5.4	2/16	82.2	>16/ >16	11.4
Piperacillin/tazobactam	≤0.5/2	95.2	1/64	75.5	1/64	86.7	1/32	88.6
Ceftriaxone	≤0.25/≤0.25	97.7	≤0.25/>32	74.9	≤0.25/32	85.6	≤0.25/16	89.9
Ceftazidime	≤0.12/0.5	97.3	0.25/>16	74.9	≤0.12/>16	85.6	≤0.12/1	93.7
Cefepime	≤0.12/≤0.12	98.0	≤0.12/4	97.1	≤0.12/4	93.3	≤0.12/0.5	97.5
Aztreonam	≤0.12/0.25	98.0	≤0.12/>16	78.4	≤0.12/16	87.8	≤0.12/4	93.7
Imipenem	0.25/0.5	100.0	0.5/2	98.8	0.25/1	100.0	0.5/2	100.0
Amikacin	2/4	100.0	2/8	95.8	2/8	96.7	2/16	93.7
Gentamicin	1/2	94.6	0.5/2	92.2	0.5/>16	82.2	0.5/16	83.5
Tobramycin	1/2	93.2	1/16	82.0	1/16	80.0	2/>16	82.3
Ciprofloxacin	≤0.015/0.12	93.9	≤0.015/>2	85.6	0.03/0.25	95.6	0.06/2	89.9
Ofloxacin	0.06/0.5	93.2	0.06/>4	83.8	0.06/1	95.6	0.25/2	93.7
Levofloxacin	≤0.5/≤0.5	93.9	≤0.5/>4	86.8	≤ 0.5/≤0.5	96.7	≤0.5/1	97.5

Table 4. Antimicrobial susceptibility (%S) and activity spectrum ($MIC_{50/90}$) of different antimicrobial agents against gram-negative organisms cultured from patients with lower respiratory tract infection.

	Isolates					
	P. aeruginosa (n=428)		*Acinetobacter spp. (n=92)*		*S. maltophilia (n=55)*	
Antimicrobial agent	$MIC_{50/90}$ μg/ml	*%Susc*	$MIC_{50/90}$ μg/ml	*%Susc*	$MIC_{50/90}$ μg/ml	*%Susc*
Piperacillin	4/>128	83.2	128/ >128	35.9	64/>128	30.9
Ticarcillin	16/>128	80.6	32/128	46.7	32/>128	43.6
Ticarcillin–clavulanate	16/128	83.4	32/>128	49.9	2/64	81.8
Piperacillin–tazobactam	4/>64	88.6	32/>64	48.9	16/>64	52.7
Ceftriaxone	16/>32	41.8	>32/>32	33.7	>32/>32	13.0
Ceftazidime	2/>16	82.9	16/>16	46.7	4/>16	70.9
Cefepime	2/16	86.9	8/>16	60.9	>16/>16	58.2
Aztreonam	4/>16	77.3	>16/>16	23.9	16/>16	43.6
Meropenem	0.25/8	86.5	1/>8	77.2	>8/>8	9.1
Imipenem	1/>8	79.4	0.5/>8	79.4	>8/>8	0.0
Amikacin	4/16	91.1	16/>32	50.0	16/>32	61.8
Gentamicin	2/>16	77.3	>16/>16	34.8	4/>16	50.9
Ciprofloxacin	0.25/>2	78.3	>2>2	38.0	0.5/>2	81.8
Ofloxacin	1/>4	70.1	>4/>4	38.0	0.5/2	96.4
Levofloxacin	≤0.5/>4	77.3	4/>4	39.1	≤0.5/1	95.7

[a]no NCCLS breakpoint defined; [b] investigational drug, no NCCLS breakpoints defined

first-line antibiotics, although the situation with *P. aeruginosa* and *Staphylococcus aureus* gives reason for concern. Close monitoring of bacterial isolates for resistance will be required.

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